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Attentional biases in PTSD: More evidence for interference

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ABSTRACT

Attentional biases to trauma-related stimuli have been widely demonstrated in individuals with posttraumatic stress disorder (PTSD). However, the majority of these studies used methods not suited to differentiating difficulty disengaging attention from threatening stimuli (interference) from facilitated detection of threat. In the current study, a visual search task (VST) with a lexical decision component was used to differentiate between attentional interference and facilitation. Forty-six sexual assault survivors with High PTSD or Low PTSD symptoms completed the VST with three types of stimuli (trauma-related, general threat-related, and semantically-related neutral words), to examine the specificity of attentional biases associated with PTSD symptoms. High PTSD participants showed increased interference to trauma-related words relative to Low PTSD participants. Furthermore, the increased attentional interference in High PTSD participants was specific to trauma-related stimuli. No evidence was found for facilitated detection of threatening stimuli in PTSD. These results provide additional support for attentional biases in PTSD relating to attentional interference with trauma-related cues rather than facilitated detection of threat. The implications for this pattern of results are discussed in relation to anxiety disorders that are characterized by rumination and/or intrusions (e.g., PTSD, GAD) rather than those more circumscribed to fight or flight response (e.g., phobias).

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Individuals with posttraumatic stress disorder (PTSD) have been shown to have attentional biases to trauma-related stimuli (e.g., Beck, Freeman, Shipherd, Hamblen, & Lackner, 2001; Buckley, Blanchard, & Neill, 2000). However, the majority of these studies are unable to disentangle the exact nature of this bias. There are different types of attentional biases such as enhanced detection of threatening stimuli (i.e., attentional facilitation) and difficulties disengaging from threat-related stimuli that result in interference with a primary task (i.e., attentional interference; Derryberry & Reed, 1994; Fox, Russo, Bowles, & Dutton, 2001). Attentional facilitation and attentional interference are distinct processes and, as such, may have different associations with the phenomenology of PTSD. However, most of the previous work on attentional bias has been conducted with either the emotional Stroop (Gotlib & McCann, 1984) or the visual dot-probe task (MacLeod, Mathews, & Tata, 1986) and these tasks do not allow for the separate assessment of these attentional processes.

Differentiating between these two types of attentional biases will increase our understanding of the exact nature of attentional biases in PTSD and may be informative to improving treatment interventions or developing primary prevention programs (Shipherd & Salters-Pedneault, 2008). Attentional interference and facilitation are important to disentangle as they would impact functioning in very different ways. For example, attentional interference to trauma-related stimuli may affect concentration, the ability to complete tasks in a timely and effective manner, and lead to an over-valuation of trauma-related information. In contrast, attentional facilitation to trauma-related stimuli may be associated with the hypervigilance symptoms of PTSD (e.g., scanning the environment for danger). One potential consequence of attentional facilitation is an increased ability to detect actual threat relatively quickly. As such, attentional facilitation may be adaptive at least in some situations, such as soldiers on a battlefield. Thus, it is important to know which types of attentional biases may be present following trauma and consider their respective implications.

In a previous study by this research team, both attentional facilitation and attentional interference were assessed in Vietnam-era

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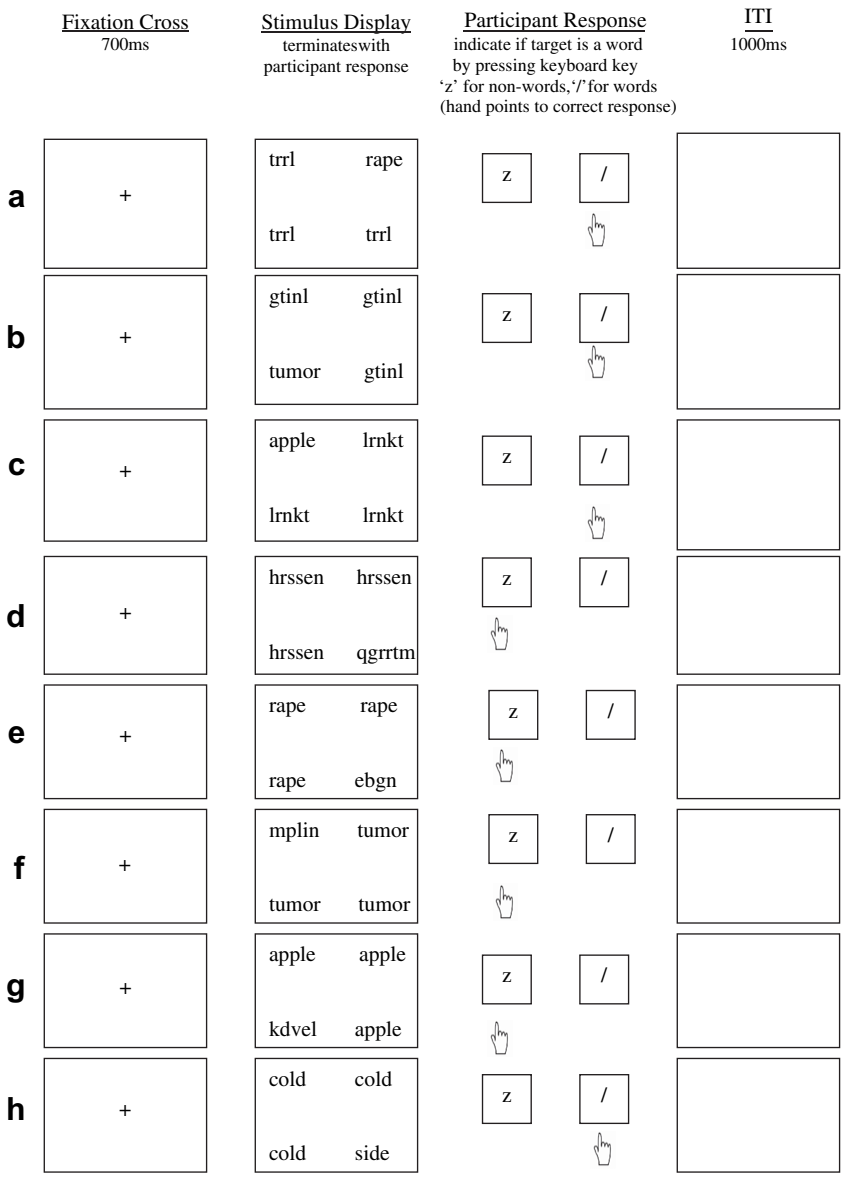

Fig. 1. Example of trial sequences from the visual search task. a) Facilitation condition experimental trial, trauma-related target and non-word distracters b) Facilitation condition experimental trial, general threat-related target and non-word distracters c) Facilitation condition experimental trial, semantically-related neutral target and non-word distracters d) Facilitation condition catch trial, non-word target and non-word distracters e) Interference condition experimental trial, non-word target and trauma-related distracters f) Interference condition experimental trial, non-word target and general threat-related distracters g) Interference condition experimental trial, non-word target and semantically-related neutral distracters h) Interference condition catch trial, uncategorized neutral target and uncategorized neutral distracters.

veterans with High and Low levels of PTSD symptoms (Pineles, Shipherd, Welch, & Yovel, 2007). Participants completed a visual search task (VST; e.g., Byrne & Eysenck, 1995; Öhman, Flykt, & Esteves, 2001; Öhman, Lundqvist, & Esteves, 2001) with a lexical decision component in which they were asked to identify a discrepant target in an array of identical stimuli (Yovel, 2003). Thus, in the earlier study (and also the current study), target and distractors were all letter strings and participants were instructed to identify if the discrepant letter string (i.e., target) was a word or non-word from an array of identical distracter letter strings. (See Fig. 1 for examples of attentional interference and attentional facilitation trials.)[1]

For attentional facilitation (Fig. 1, items a–d), the trials of interest were comprised of a trauma-related word or a semantically-related neutral word as the target embedded in an array of non-word distractors. Attentional facilitation to trauma-related words was operationalized as *faster* reaction times (RTs) to trauma-related trials as compared to RTs with the semantically-related neutral target. In the earlier study, the High and Low PTSD symptom level groups did not differ on attentional facilitation to trauma-related stimuli.

For attentional interference (Fig. 1, items e–h), the trials of interest were comprised of non-word targets and the distractors were either an array of identical trauma-related words or an array of identical categorized neutral words. Attentional interference to trauma-related words was operationalized as *slower* RTs to arrays with trauma-related distractors as compared to those with the semantically-related neutral distractors. In the earlier study,

[1] There were no general threat-related trials stimuli in the Pineles et al. (2007) study.

Vietnam-era veterans with High levels of PTSD symptoms showed relatively greater attentional interference to trauma-related stimuli compared to those with lower symptom levels, but only when they completed the interference task first.

Thus, there is one study to suggest that individuals with high levels of PTSD symptoms exhibit attentional interference, but not attentional facilitation, to trauma-related stimuli. While no other studies examining these two types of biases separately in PTSD exist, similar results have been found in studies of attentional biases with other anxiety disorders. Individuals with different types of anxiety disorders (e.g., social phobia, GAD) and high trait anxiety have relatively more difficulty disengaging from threatening stimuli (attentional interference) than individuals with lower anxiety levels (e.g., Byrne & Eysenck, 1995; Fox et al., 2001; Fox et al., 2002; Gilboa- Schechtman, Foa, & Amir, 1999; Rinck, Becker, Kellermann, & Roth, 2003, Experiment 2). When interpreting the one study that failed to find evidence for attentional facilitation in PTSD, it is important to note that the larger anxiety disorder literature has mixed findings with attentional facilitation (see Byrne & Eysenck, 1995; Gilboa- Schechtman et al., 1999; Öhman, Flykt, et al., 2001, Experiment 3, for positive results; see Fox et al., 2000; Rinck & Becker, 2005; Rinck et al., 2003, for negative results).

Together, the combined anxiety disorder literature (including PTSD, GAD, social phobia, etc.) finds fairly consistent evidence for increased attentional interference to threat-related stimuli. In contrast, the evidence regarding increased attentional facilitation to such stimuli in anxiety disorders is weak at best. The relative lack of empirical support for attentional facilitation runs counter to several theories of attentional biases in anxiety disorders (see Eysenck, 1997; Mogg & Bradley, 1998; Weierich, Treat, & Hollingworth, 2008, for a review) which purport that anxious individuals' attention is selectively biased toward anxiety-related or threatening stimuli. Because there is only one study examining attentional interference and facilitation separately in PTSD that showed null results for facilitation (Pineles et al., 2007), the current study is a replication and extension of that previous study.

First, we sought to replicate our findings in a different sample. The previous study used a sample of male Vietnam-era veterans. Thus, in an effort to generalize our findings to trauma survivors more broadly, the current study participants were female sexual assault survivors. Second, the current study examines whether attentional interference and facilitation in PTSD are specific to trauma-related words or generalize to general threat-related words more broadly. Previous emotional Stroop studies have demonstrated specificity of attentional biases in PTSD to trauma-related words (e.g., Beck et al., 2001; Foa, Feske, Murdock, Kozak, & McCarthy, 1991; McNally, Kaspi, Riemann, & Zeitlin, 1990). The current study investigates the specificity of both attentional interference and facilitation to trauma-related stimuli in PTSD.

It was hypothesized that sexual assault survivors with High PTSD symptom levels would show greater attentional interference to trauma-related words relative to general threat-related and semantically-related neutral words as compared to those with Low PTSD symptom levels. We also examined if female sexual assault survivors with High PTSD symptom levels showed greater attentional facilitation to trauma-related stimuli relative to general threat-related and semantically-related neutral stimuli.

Method

Participants

Forty-six women who had experienced a sexual assault (both veterans and non-veterans) were recruited from a VA hospital and the community using flyers and online postings. The women were divided into two groups: High PTSD and Low PTSD, based on responses to the PTSD Checklist, specifically anchored to the unwanted sexual experience that "bothers you the most today" (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993). The PCL is a 17-item self-report scale that includes one item for each symptom of PTSD according to the American Psychiatric Association (*DSM-IV-TR*, 2000). Participants rated the degree to which they were bothered by each symptom over the past month on a 5-point scale ranging from 1: "Not at all" to 5: "Extremely" (sum score range 17–85). The PCL is internally consistent ($\alpha = .97$), has high test-retest reliability over 2–3 days ($r_t = .96$, Weathers et al., 1993), appears to have good sensitivity (0.72) and specificity (0.86 Terhakopian, Sinaii, Engel, Schnurr, & Hoge, 2008) and has good concordance with standardized interviewing for PTSD (Monson, Gradus, Young-Xu, Schnurr, & Price, 2008). In the present study, similar internal consistency was found ($\alpha = .93$). There is no standard cut-off score for clinically significant symptoms of PTSD in samples from the general population (Terhakopian et al., 2008). The closest relevant cut-off score is 50 used with samples of veterans (Forbes, Creamer, & Biddle, 2001; Weathers et al., 1993) and sexual assault survivors (Blanchard, Jones- Alexander, Buckley, & Forneris, 1996).

To be consistent with the earlier study and reflecting *DSM-IV-TR* (2000) criteria for PTSD diagnosis, inclusion criteria for the High PTSD group were two-fold: 1) A total score of 50 or above on the PCL, and 2) A score of "3" (moderately) or above on at least one intrusion symptom, three avoidance symptoms, and two arousal symptoms ($n = 24$). For inclusion in the Low PTSD group, participants needed a score under 50 on the PCL and a score below "3" on the requisite number of symptoms to meet criteria for PTSD diagnosis ($n = 19$). Three additional participants were excluded from analyses because they did not meet criteria for either group. As would be predicted, the High PTSD group reported more PTSD symptoms, as well as higher depression and anxiety levels than the Low PTSD group (see Table 1). The High and Low PTSD groups did not differ in terms of age, ethnicity, marital status, parental status religion, psychotropic medication use, or recent drug or alcohol use (all p's $> .05$; see Table 1).

Stimuli

Four types of words were used as stimuli: trauma-related words, general threat-related words, semantically-related neutral words, uncategorized neutral words and unpronounceable letter strings ("non-words"). The trauma-related words, general threat-related words and semantically-related neutral words were used in an earlier emotional Stroop study by Foa et al. (1991). The trauma-related (e.g., rape, assault) words were rated a) as having a high threat value by rape survivors and low threat value by nonvictimized control participants, and b) as equivalent on perceived usage frequency by both participant groups (Foa et al., 1991). The general threat-related words (e.g., anxiety, cancer) and semantically-related neutral words (e.g., banana, prune)[2] originated from a previous study of attentional biases (McCarthy, Foa, Murdock, & Ilia, 1990, unpublished manuscript). In the McCarthy study, the general threat-related words were rated as having a high threat value and equivalent on perceived use by three groups of anxious participants and a nonclinical control group. In addition, the semantically-related neutral words were rated as

[2] In the Foa et al. (1991) study, the response latency for the neutral word 'grape,' was similar to the response latency for the sexual assault related word 'rape.' Therefore, for the current study, the word 'plum' was substituted for 'grape'.

Table 1
Characteristics of participants in the High and Low PTSD groups.

	High PTSD ($n = 24$)	Low PTSD ($n = 19$)	
Age, mean (*SD*)	46.6 (11.5)	47.3 (11.8)	$t(41) = .18$, *n.s.*
Have children, % (*n*)	54.2 (13)	73.7 (14)	$x^2 = 1.73$, *n.s.*
Ethnicity, % (*n*)			$x^2 = 2.26$, *n.s.*
Caucasian	58.3 (14)	36.8 (7)	
African-American	25 (6)	31.6 (6)	
Hispanic/Latino	4.2 (1)	10.5 (2)	
Other	12.5 (3)	21.1 (4)	
Education, % (*n*)			$x^2 = 6.73$, *n.s.*
HS Diploma/GED	4.2 (1)	26.3 (5)	
Some college	37.5 (9)	21.1 (4)	
Associates degree	16.7 (4)	21.1 (4)	
BA/BS or higher	20.8 (5)	15.8 (3)	
Some graduate school	4.2 (1)	10.5 (2)	
Graduate Degree	16.7 (4)	5.3 (1)	
Employment status, % (*n*)			$x^2 = 4.41$, *n.s.*
Full-time	20.8 (5)	15.8 (3)	
Part-time	8.3 (2)	10.5 (2)	
Unemployed	20.8 (5)	21.1 (4)	
Disabled	50 (12)	36.8 (7)	
Retired	0 (0)	10.5 (2)	
Volunteer	0 (0)	5.3 (1)	
Marital status, % (*n*)			$x^2 = 3.97$, *n.s.*
Single	41.7 (10)	31.6 (6)	
Married	12.5 (3)	26.3 (5)	
Partnered	8.3 (2)	21.1 (4)	
Separated/divorced	33.3 (8)	21.1 (4)	
Widowed	4.2 (1)	0 (0)	
Religion, % (*n*)			$x^2 = .91$, *n.s.*
Catholic	29.2 (7)	21.1 (4)	
Protestant	16.7 (4)	15.8 (3)	
Jewish	4.2 (1)	10.5 (2)	
Other	50 (12)	52.6 (10)	
PCL, mean (SD)	63.5 (10.2)	36.4 (9.1)	$t(41) = 9.08$, $p < .001$
BDI,[a] mean (*SD*)	26.7 (8.2)	10.6 (8.2)	$t(40) = 6.28$, $p < .05$
STAI-Trait,[a] mean (*SD*)	57.8 (8.1)	40.7 (9.9)	$t(40) = 6.15$, $p < .05$
STAI-State,[a] mean (*SD*)	51.4 (9.3)	38.1 (10.8)	$t(40) = 4.27$, $p < .05$
Psychotropic medication use, % (*n*)	70.8% (17)	42.1% (8)	$x^2 = 2.69$, *n.s.*
Used alcohol or drugs within the past 24 hours,[a] % (*n*)	0% (0)	12.5% (2)	$x^2 = 3.60$, *n.s.*

Note. PCL = PTSD Checklist; BDI = Beck Depression Inventory; STAI-Trait = State/Trait Anxiety Inventory-Trait score; STAI-State = State/Trait Anxiety Inventory-State score. Psychotropic medication use was defined liberally in this sample and included other medications that may impact mood and anxiety such as beta blockers, opioid pain medications, and sleeping medications.

[a] Due to missing data on these measures, $n = 18$ for the Low PTSD group.

nonthreatening and were rated as equivalent in perceived usage across all four groups. Trauma-related words, general threat-related words, and semantically-related neutral words were matched for length and perceived frequency of usage (Foa et al., 1991). In the current study, good internal consistency within word type was found (αs range from .74 to .93). The uncategorized neutral words (e.g., cotton) and non-words (e.g., ncotlk) were used in previous studies of attentional biases (Pineles et al., 2007; Yovel, 2003). A complete listing of the categorized words used has been included in Appendix.

Apparatus

Stimuli for the VST were presented on a 19″ monitor (800 × 600, 60 Hz) using Superlab software (Version 2; Cedrus Research, 1999) with a Dell Dimension XPS T500 computer. Response latencies and accuracy rates were recorded by the computer.

Procedure

Participants were tested individually in a 2 h session during which they completed the VST, the PCL, a demographics questionnaire including items about medication and substance usage, Beck Depression Inventory (BDI; Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961), State and Trait Anxiety (STAI; Spielberger, Gorsuch, & Lushene, 1970), as well as several other self-report measures not analyzed for this study. The VST included two conditions (interference and facilitation) that were completed sequentially. Order of these conditions was randomized and counterbalanced across participants.

As with the earlier study, participants read instructions for each condition with a research assistant present and performed 20 practice trials with visual feedback for incorrect responses to familiarize them with the task. The letter strings were equally spaced around a 111 mm × 46 mm (distance 40 cm, visual angles of roughly 16.0° × 6.6°) rectangular shape. Stimuli were displayed on a white background in black, bold, Times New Roman, size-24 font (approximately .4° high, length 1.9° for a 7-letter word). Each trial began with a black fixation cross at the center of the white screen for 700 ms. The fixation cross was immediately followed by the stimulus trial that remained on the screen until a response was made (ITIs = 1000 ms). Two-thirds of the trials in each condition were experimental trials while the remaining third were catch trials.

Consistent with the earlier study, participants were instructed to indicate if the 'oddball' letter string was a word or a non-word by pressing one of the two designated keyboard keys as quickly and accurately as possible for both the interference and facilitation conditions ('/' for words, 'z' for non-words). In both conditions, the 'oddball' was presented in an array of three otherwise identical letter strings matching the 'oddball' in length. In the interference condition, experimental trials included one non-word (the target) and three experimental words (i.e., trauma-related words, general threat-related words or semantically-related neutral words) with matching word length. Catch trials (included for participant engagement purposes) consisted of three identical uncategorized neutral words and one different uncategorized neutral word that served as the target. In the facilitation condition, experimental trial displays consisted of one target experimental word (i.e., trauma-related words, general threat-related words or semantically-related neutral words) and three identical non-word distractors with matching word length. Catch trials included a target non-word and three identical non-words (different than the target; See Fig. 1 for an example of the trial sequence).

The stimulus arrays in the current study included only four letter strings rather than arrays of 4, 6, and 8 as in the previous study (Pineles et al., 2007). This methodological change was made for two reasons. First, it is possible that habituation related to the large number of trials of the VST may have contributed to the finding that individuals with high levels of PTSD symptoms exhibited increased attentional interference to trauma-related stimuli only when they completed the attentional interference task first. Second, Öhman, Flykt, et al. (2001) found that attentional facilitation was enhanced with smaller arrays and post-hoc exploration of the Pineles et al. (2007) attentional facilitation data suggested somewhat greater PTSD group differences for attentional facilitation to trauma-related stimuli in early trials relative to later trials. Although these results did not reach statistical significance, it is possible that smaller arrays and fewer trials may increase the likelihood of detecting attentional facilitation effects. Thus, to maximize our chances of obtaining facilitation findings, we included fewer trials, using only arrays of four.

Participants completed 180 trials in four blocks, separated by 30s breaks. There were two blocks of interference trials and two of facilitation trials (90 trials per condition). Within each condition, 60 trials were experimental trials and 30 were catch trials. Of the 60 experimental trials, 20 of the trials consisted of trauma-related stimuli, 20 consisted of general threat-related stimuli, and 20 were semantically-related neutral words (Fig. 1). Each experimental word was presented once per block. The order of the trials within the interference and facilitation conditions as well as the location of the target were randomly generated and the assignment of the two conditions (interference first or facilitation first) was counterbalanced over participants. After the VST, self-report measures were administered. Lastly, participants were debriefed, thanked, and compensated $20.

Results

Error trials (wrongful identification of word status) were discarded (average error rate was 4.19%) and replaced for each participant with the series mean for that trial type. In addition, VST data were excluded from two participants. One excluded participant had an error rate of 48% and another participant was excluded based on extremely slow reaction times. Her average response latency exceeded the mean total RT score for the trials of interest by more than 3 SDs.

Interference condition

A 2 Group X 2 Order X 3 Word Type X 2 Block X 10 Trials mixed-design ANOVA was conducted on the latency data (RTs) with two between-subject variables, Group (High PTSD, Low PTSD) and Order (interference first, facilitation first) and three within-subject variables, Word Type (trauma-related, general threat-related, semantically-related neutral), Block (2), and Trials (10).[3] All significance levels reported below for analyses that included the Word Type effect reflect the Greenhouse–Geisser correction for sphericity. However, in order to minimize possible confusion arising from different degrees of freedom being reported for similar analyses, we report the degrees of freedom associated with the unadjusted tests.

The main effect of Group was significant ($F(1, 37) = 8.11$, $\eta_p^2 = .18$, $p < .05$). Individuals in the High PTSD group ($m = 1612$, $SD = 492$) exhibited slower RTs on average as compared to the Low PTSD group ($m = 1291$, $SD = 530$). The main effect of Word Type was also significant ($F(2, 74) = 4.52$, $\eta_p^2 = .11$, $p < .05$) and pairwise comparisons revealed that RTs to the trauma-related stimuli ($m = 1493$, $SD = 343$) were significantly slower than RTs to general threat-related ($m = 1432$, $SD = 371$, $p < .05$) and semantically-related neutral stimuli ($m = 1429$, $SD = 400$, $p < .05$), but that general threat and semantically-related neutral stimuli did not differ from each other. In addition, there were significant main effects of Block ($F(1, 37) = 6.83$, $\eta_p^2 = .16$, $p < .05$) and Trials ($F(9, 333) = 2.72$, $\eta_p^2 = .07$, $p < .05$). These main effects reflected participants responding more quickly over the course of the study. Participants responded faster during block 2 ($m = 1408$, $SD = 364$) than block 1 of interference trials ($m = 1495$, $SD = 390$) and the Trials main effect best fit linear model ($p < .05$), with participants responding more quickly over time. However, interpretation of these main effects must consider the interactions described below.

Significant interactions included: Word Type X Block ($F(2,74) = 12.06$, $\eta_p^2 = .25$, $p < .05$), Order X Trial ($F(9,333) = 2.20$, $\eta_p^2 = .06$, $p < .05$), Group X Order X Block ($F(1,37) = 4.54$, $\eta_p^2 = .11$, $p < .05$), and Group X Order X Word Type ($F(2,74) = 3.64$, $\eta_p^2 = .09$, $p < .05$). To breakdown these interactions, a series of pairwise comparisons, using comparison-specific error terms for effects involving the within-subject factor were conducted. Comparisons deconstructing the Word Type × Block interaction revealed that participants had similar response latencies to semantically-related neutral stimuli in both blocks (Block 1: $m = 1423$, $SD = 406$; Block 2: $m = 1436$, $SD = 440$, *n.s.*). However, participants were significantly faster to both trauma-related and general threat-related stimuli in block 2 (Trauma: $m = 1396$, $SD = 341$; General Threat: $m = 1392$, $SD = 359$) as compared to block 1 (Trauma: $m = 1590$, $SD = 405$; General Threat: $m = 1473$, $SD = 411$, p's $< .05$). Thus, while participants were faster over the course of the task, this was only true for the trauma-related and general threat-related words, not for semantically-related neutral words. The Order × Trial interaction reflects that participants who completed the Facilitation task first had a slightly different pattern of response latencies over the course of interference trials (with the slowest RT on the first trial and the fastest RT on the ninth trial) compared to those who completed the Interference task first (with the slowest RT on the fifth trial and the fastest RT on the ninth trial). However, there were no significant differences between the two conditions (interference first versus facilitation first) on response latencies to individual trials.

The Group X Order × Block interaction demonstrated that for participants who completed the Facilitation task first, the High PTSD group responded more slowly than the Low PTSD group on both block 1 (High PTSD: $m = 1656$, $SD = 750$; Low PTSD: $m = 1294$, $SD = 829$, $p < .05$) and block 2 (High PTSD: $m = 1611$, $SD = 701$; Low PTSD: $m = 1203$, $SD = 775$, $p < .05$) of interference trials. In addition, for those who completed the Facilitation task first, response latencies were equivalent from block 1 to block 2 of interference trials, within each PTSD Group. For participants who completed the Interference task first, the High PTSD group responded more slowly than the Low PTSD group only on block 1 of interference trials (High PTSD: $m = 1705$, $SD = 750$; Low PTSD: $m = 1326$, $SD = 786$, $p < .05$). Furthermore, the High PTSD group had faster response times on block 2 ($m = 1478$, $SD = 701$) as compared to block 1 ($m = 1705$, $SD = 750$, $p < .05$) of interference trials. There were no other significant contrasts related to this interaction. Taken together, these results demonstrate that regardless of task order, the High PTSD group responded more slowly than the Low PTSD group on the first block of interference trials. However, the High PTSD group only responded more slowly than the Low PTSD group on the second block if they completed the facilitation task first.

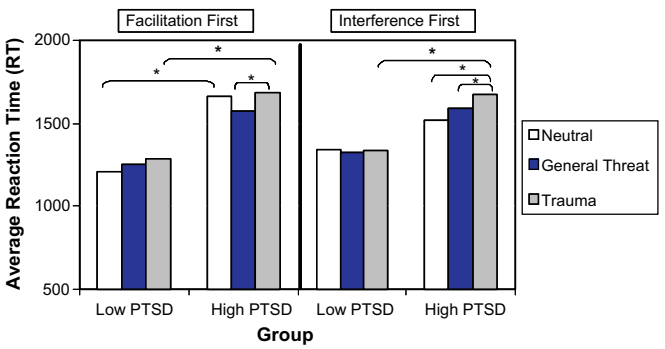

Fig. 2. Differences in reaction times to interference trials in individuals who completed the interference versus facilitation condition first. Significant contrasts are marked with an asterisk ($p < .05$).

[3] When age was entered as a covariate in the interference condition ANOVA, the main effect of PTSD group and the three-way interactions of Group X Order X Block ($F(1, 36) = 5.10$, $p < .05$) and Group X Order X Word Type remained significant ($F(2, 72) = 3.58$, $p < .05$). There were no other significant main effects or interactions.

Finally, the Group X Order X Word Type was deconstructed (Fig. 2). For participants in both Orders, High PTSD group participants exhibited slower RTs to the trauma-related words (Interference first: $m = 1670$, $SD = 661$; Facilitation first: $m = 1677$, $SD = 661$) compared to those in the Low PTSD group (Interference first: $m = 1334$, $SD = 693$; Facilitation first: $m = 1290$, $SD = 731$, p's $< .05$). Additionally, across both Orders, individuals in the High PTSD group exhibited slower RTs to the trauma-related words (Interference first: $m = 1670$, $SD = 661$; Facilitation first: $m = 1677$, $SD = 661$) as compared with general threat-related words (Interference first: $m = 1589$, $SD = 714$; Facilitation first: $m = 1566$, $SD = 714$, p's $< .05$). However, the patterns of results for the semantically-related neutral trials varied by Order. For High PTSD participants who completed the Interference task first, RTs to semantically-related neutral words ($m = 1515$, $SD = 770$) were significantly faster compared to both general threat-related words ($m = 1589$, $SD = 714$, $p < .05$) and trauma-related words ($m = 1670$, $SD = 661$, $p < .05$). The High and Low PTSD Groups did not differ on their RTs to semantically-related neutral words for participants in the Interference task first Order. Participants who completed the Facilitation task first with High PTSD symptoms responded significantly slower on the semantically-related neutral words ($m = 1657$, $SD = 770$) than Low PTSD participants ($m = 1205$, $SD = 851$, $p < .05$) on the interference trials. None of the remaining direct comparisons of RTs at each level of the remaining levels of the interaction were significant. Thus, the results of this three-way interaction show that the High PTSD group showed slower RTs to the trauma-related words relative to the Low PTSD group regardless of task order. Also regardless of task order, High PTSD participants responded more slowly to trauma-related stimuli than to general threat-related stimuli. However, PTSD group differences in RTs to semantically-related neutral stimuli were dependent on task order. Specifically, for those who completed the interference task first, 1) the High and Low PTSD groups did not differ in RTs to the neutral stimuli; and 2) the High PTSD group responded more slowly to trauma-related stimuli as compared to the general threat or semantically-related neutral stimuli. In contrast, for those who completed the facilitation task first, 1) the High PTSD group was slower to respond to the semantically-related neutral stimuli than the Low PTSD group; and 2) the High PTSD group did not differ in response latencies to trauma-related stimuli as compared to the neutral stimuli.

In sum, the High PTSD group exhibited greater attentional interference for trauma-related words relative to the Low PTSD group. In addition, attentional interference in individuals with High PTSD symptom levels appears to be specific to trauma-related stimuli, rather than related to general threat stimuli more broadly. However, consistent with our previous study (Pineles et al., 2007), there appeared to be task order effects. In the current study, the task order effects related to PTSD Group differences in attentional interference appear to be primarily due to differences in RTs to semantically-related neutral words depending on the order of task completion.

Facilitation condition

A 2 Group X 2 Order X 3 Word Type X 2 Block X 10 Trials mixed-design ANOVA was conducted on the latency data (RTs) with two between-subject variables, Group (High PTSD, Low PTSD) and Order (interference first, facilitation first) and three within-subject variables, Word Type (trauma-related, general threat-related, semantically-related neutral), Block (2), and Trials (10).[4] The main effect of Word Type was significant ($F(2,74) = 23.54$, $\eta_p^2 = .39$, $p < .05$). Pairwise comparisons revealed that overall participants exhibited slower RTs to the trauma-related words ($m = 1568$, $SD = 343$) compared to both the general threat-related ($m = 1384$, $SD = 333$; $p < .05$) and the semantically-related neutral words ($m = 1411$, $SD = 288$). In addition, there were significant main effects of Block ($F(1, 37) = 26.94$, $\eta_p^2 = .42$, $p < .05$) and Trials ($F(9, 333) = 3.34$, $\eta_p^2 = .08$, $p < .05$). These main effects reflected participants responding more quickly over the course of the study. Participants responded faster during the second block ($m = 1346$, $SD = 300$) than the first block ($m = 1563$, $SD = 362$, $p < .0005$) and the Trials main effect best fit linear model ($p < .05$), with participants responding more quickly over time. No other main effects or interactions were significant. Thus, we did not find evidence for attentional facilitation to trauma-related words in individuals with High PTSD.

Discussion

This study had two primary aims. The first aim was to replicate the earlier findings of attentional interference in High PTSD participants (Pineles et al., 2007) in a sample of female sexual assault survivors. The second aim was to examine the specificity of attentional difficulties by examining both trauma-related words and general threat words for the first time in trauma survivors. Indeed, this study replicated that attentional interference from trauma-related words was present for High PTSD female sexual assault survivors, with no support for attentional facilitation toward trauma words. In addition, support for the specificity of attentional interference was found. Specifically, the increased attentional interference exhibited by the High PTSD participants was only found for trauma-related stimuli and did not generalize to general threat-related stimuli. The results suggest that increased attentional interference in individuals with High PTSD symptom levels is specific to trauma-related stimuli and is consistent with the larger Stroop literature with trauma survivors (e.g., Beck et al., 2001; Foa et al., 1991; McNally et al., 1990). Thus, it appears that individuals with High PTSD symptoms levels do not have difficulty disengaging from threat in general. Instead, they have specific difficulties disengaging from trauma reminders to redirect attention to task-related performance.

Difficulty disengaging from trauma-related stimuli may be an important maintaining factor for PTSD. Individuals with PTSD experience intense distress when encountering reminders of traumatic events and this distress may contribute to the difficulty in disengaging from these cues through the activation of fear structures (Foa et al., 1991; Foa & Kozak, 1986). In turn, the difficulty disengaging from the trauma cues may intensify and prolong the distress. Furthermore, the distress and difficulty disengaging from the trauma cues may contribute to the use of avoidance behaviors in an effort to minimize or avoid the distress (Shipherd & Beck, 2005; Shipherd, Stafford, & Tanner, 2005; Stewart, 1996). These avoidance behaviors have been posited to be of great importance in the maintenance of PTSD as they may interfere with habituation from natural exposures to trauma (e.g., Foa, Zinbarg, & Rothbaum, 1992). Importantly, all participants were survivors of sexual assault. Therefore, it was not trauma exposure per se that accounted for these findings, but rather differences between the High PTSD and Low PTSD groups. Participants in the High PTSD group were slower to respond to the trauma-related words compared to Low PTSD participants, irrespective of condition. Participants in the High PTSD group also responded more slowly to trauma-related words compared to general threat-related words, whereas participants in the Low PTSD group did not differ in reaction times to these types of stimuli.

[4] When age was entered as a covariate, there were no significant main effects or interactions.

When considering attentional interference as impacting habituation in the natural environment, it is important to note that the experimental manipulation itself may have useful treatment implications. Specifically, faster RTs were noted over time for the trials with general threat-related and trauma-related stimuli, but not the semantically-related neutral stimuli. This result may be attributed to the process of habituation with the negatively valenced stimuli. Because brief presentations of words are relatively minor threats, habituation to these stimuli may occur relatively quickly and may be causing the relative increased speed on general threat and trauma-related trials. These findings of faster responses over time in the face of trauma-related stimuli may provide support for the testing of attention training interventions in PTSD (cf., Shipherd & Salters-Pedneault, 2008).

While it is true that there was a task Order effect related to PTSD group differences in attentional interference, this finding appears to be driven by High PTSD participants responding slower to semantically-related neutral words if they did the facilitation task first. This lends further support for use of an attentional retraining task focused on reducing attentional interference to trauma-related words. In this way, lab-based intervention techniques could include stimulus presentations designed to enhance habituation. Given the relevance of habituation processes, it is also important to consider these findings within the context of the larger attention literature in other anxiety disorders. Several studies have found support for attentional interference in other anxiety disorders (Byrne & Eysenck, 1995; Fox et al., 2001, 2002; Gilboa- Schechtman et al., 1999; Pineles et al., 2007; Rinck et al., 2003, Experiment 2), which suggests that attention interference may be present in a wide array of anxiety disorders. This pattern of results has not been found for attentional facilitation. In the current study, there was still no evidence for attentional facilitation to trauma-related words in High PTSD participants despite methodological changes (e.g., decreasing the number of trials, using smaller arrays) designed to increase the likelihood of detecting attentional facilitation. In contrast to the evolutionary advantages associated with quick detection of threat, it is difficult to identify advantages of having trouble disengaging from a potentially threatening stimulus. In fact, this finding runs counter to clinical lore about facilitated attention in hypervigilant PTSD patients. Thus, attentional interference might be a risk factor or maintaining factor associated with both PTSD and other anxiety disorders. A parsimonious explanation for these null results is that attentional facilitation may be a relatively weak or even nonexistent phenomenon in PTSD and other disorders where rumination and intrusions are paramount (such as GAD). Thus, for ruminative and intrusive anxiety disorders (e.g., PTSD, OCD, GAD) the psychopathology may be limited to difficulty disengaging from threat (attentional interference). In contrast, other anxiety disorders such as phobias may be particularly characterized both by difficulty disengaging and by the quick detection of threat (cf., Pineles et al., 2007). This may be particularly true when the feared targets are natural or evolutionarily-based threats (e.g., threatening faces, snakes, spiders; Öhman & Mineka, 2001).

Alternatively, it is possible that other methodological features of the VST used in the current study that may have contributed to the null results. Rinck, Reinecke, Ellwart, Heuer, and Becker (2005) suggested that the use of superficial searches increased the likelihood of detecting attentional facilitation effects. However, the current study's methods had two features (lexical decision, words as stimuli) that required participants to engage in a deeper level of semantic processing, possibly increasing error variance by adding additional steps of processing to the task. Importantly, however, the use of words as stimuli was deemed necessary in the study of attentional processes in PTSD because this type of stimuli allows for the capture of a wider range of experiences than would have been possible with pictorial stimuli.

Although this study investigated how individuals with High and Low levels of PTSD symptoms differ on visual attention to certain types of stimuli, it is important to note that these attentional biases may not be due to PTSD symptoms per se, but may be more broadly related to increased general anxiety or depression. Similar to most studies of PTSD, the participants in the High PTSD group showed increased symptoms of depression and state anxiety compared to the Low PTSD group. These factors may contribute to the group differences in attention. Because of the current study's relatively small sample size and the high degree of overlap between these different constructs and PTSD symptoms, we were unable to assess if attentional biases to trauma-related symptoms were associated with PTSD symptoms specifically or with trait anxiety or mood symptoms more generally. Therefore, the comorbidity of additional ruminative problems (e.g., depression) may have enhanced the attentional interference.

There are other limitations that are important to note. For example, arousal ratings for the different stimuli types were not collected from the current study's participants and therefore there was no data available to assess PTSD group differences in the subjective threat and arousal levels for the different stimulus types. In addition, when age was included in the mixed-design ANOVAs, there were no longer any significant effects for the facilitation trials and several of the main effects and interactions were no longer significant for the interference trials. This suggests that some of the findings may be magnified as women age. However, it is also possible that the loss of these effects was due to insufficient power when another predictor was added to the model. Regardless, it is important to note that the two interactions including PTSD group remained significant. Finally, the PTSD groups were formed based on self-report that did not account for functional impairment rather than diagnostic interviews. Although the PCL and the Clinician Administered PTSD scale have been shown to be highly concordant (Monson et al., 2008), replicating these effects with PTSD groups based on diagnostic interviews is an important area for future research.

To summarize, the current study provided evidence for the specificity of enhanced attentional interference of trauma-related words, and extended previous findings in PTSD to women with High PTSD symptom levels. High PTSD participants had more difficulty disengaging from trauma-related words than did Low PTSD participants. The current study shows that this effect generalizes to female sexual assault survivors, thus providing evidence for the robustness of enhanced attentional interference in High PTSD symptom groups. In addition, there was evidence for specificity of enhanced attentional interference to trauma-related words in individuals with High PTSD symptom levels. Consistent with our earlier study, and despite methodological changes to increase chances of detecting facilitated attention, no support was found for attentional facilitation to trauma-related stimuli in individuals with High PTSD symptom levels. Thus, there is growing evidence for attentional biases in PTSD relating more to attentional interference than facilitation.

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Appendix

Categorized words.

Trauma-related	General threat-related	Semantically-related neutral
Rape	Anxiety	Banana
Assault	Death	Cherry
Stalker	Cancer	Plum
Scream	Tumor	Raisin
Struggle	Stress	Apple
Trapped	Funeral	Prune
V.D.	Panic	Peach
Penetrate	Coffin	Strawberry
Nightmare	Guilt	Melon
Attack	Nervous	Pear

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (Revised 4th ed.). Washington, DC: Author.

Beck, A. T., Ward, C. H., Mendelsohn, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561–571.

Beck, J. G., Freeman, J. B., Shipherd, J. C., Hamblen, J. L., & Lackner, J. M. (2001). Specificity of stroop interference in patients with pain and PTSD. *Journal of Abnormal Psychology, 110*, 536–543.

Blanchard, E. B., Jones- Alexander, J., Buckley, T. C., & Forneris, C. A. (1996). Psychometric properties of the PTSD Checklist (PCL). *Behaviour Research and Therapy, 34*, 669–673.

Buckley, T. C., Blanchard, E. B., & Neill, W. T. (2000). Information processing and PTSD: a review of the empirical literature. *Clinical Psychology Review, 20*, 1041–1065.

Byrne, A., & Eysenck, M. W. (1995). Trait anxiety, anxious mood and threat detection. *Cognition and Emotion, 9*, 549–562.

Derryberry, D., & Reed, M. A. (1994). Temperament and attention: orienting toward and away from positive and negative signals. *Journal of Personality and Social Psychology, 66*, 1128–1139.

Eysenck, H. J. (1997). Personality and experimental psychology: the unification of psychology and the possibility of a paradigm. *Journal of Personality and Social Psychology, 73*, 1224–1237.

Foa, E. B., Feske, U., Murdock, T. B., Kozak, M. J., & McCarthy, P. R. (1991). Processing of threat-related information in rape victims. *Journal of Abnormal Psychology, 100*, 156–162.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: exposure to corrective information. *Psychological Bulletin, 99*, 20–35.

Foa, E. B., Zinbarg, R., & Rothbaum, B. O. (1992). Uncontrollability and unpredictability in post-traumatic stress disorder: an animal model. *Psychological Bulletin, 112*, 218–238.

Forbes, D., Creamer, M., & Biddle, D. (2001). The validity of the PTSD checklist as a measure of symptomatic change in combat-related PTSD. *Behaviour Research and Therapy, 39*, 977–986.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: are angry faces detected more efficiently? *Cognition and Emotion, 14*, 61–92.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw of hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General, 130*, 681–700.

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: evidence for delayed disengagement from emotional faces. *Cognition and Emotion, 16*, 355–379.

Gilboa- Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: the face-in-the-crowd paradigm. *Cognition and Emotion, 13*, 305–318.

Gotlib, I. H., & McCann, C. D. (1984). Construct accessibility and depression: an examination of cognitive and affective factors. *Journal of Personality and Social Psychology, 47*, 427–439.

McCarthy, P. R., Foa, E. B., Murdock, T., & Ilia, D. (1990). Attentional bias in obsessive–compulsive disorder: A test using a modified Stroop task. Unpublished manuscript, Medical College of Pennsylvania, Department of Psychiatry, Philadelphia.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15–20.

McNally, R. J., Kaspi, S. P., Riemann, B. C., & Zeitlin, S. B. (1990). Selective processing of threat cues in posttraumatic stress disorder. *Journal of Abnormal Psychology, 99*, 398–402.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36*, 809–848.

Monson, C. M., Gradus, J. L., Young-Xu, Y., Schnurr, P. P., & Price, J. L. (2008). Change in posttraumatic stress disorder symptoms: do clinicians and patients agree? *Psychological Assessment, 20*, 131–138.

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: detecting the snake in the grass. *Journal of Experimental Psychology: General, 130*, 466–478.

Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: a threat advantage with schematic stimuli. *Journal of Personality and Social Psychology, 80*, 381–396.

Öhman, A., & Mineka, S. (2001). Fears, phobias and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108*, 483–522.

Pineles, S. L., Shipherd, J., Welch, L., & Yovel, I. (2007). The role of attentional biases in PTSD: is it interference or facilitation. *Behaviour Research and Therapy, 45*, 1903–1913.

Rinck, M., & Becker, E. S. (2005). A comparison of attentional biases and memory biases in women with social phobia and major depression. *Journal of Abnormal Psychology, 114*, 62–74.

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: distraction and enhancement in visual search. *Depression and Anxiety, 18*, 18–28.

Rinck, M., Reinecke, A., Ellwart, T., Heuer, K., & Becker, E. S. (2005). Speeded detection and increased distraction in fear of spiders: Evidence from eye movements. *Journal of Abnormal Psychology, 114*, 235–248.

Shipherd, J. C., & Beck, J. G. (2005). The role of thought suppression in posttraumatic stress disorder. *Behavior Therapy, 36*, 277–287.

Shipherd, J. C., & Salters-Pedneault, K. A. (2008). Attention, memory, intrusive thoughts and acceptance in PTSD: an update on the empirical literature for clinicians. *Cognitive and Behavioral Practice, 15*, 349–363.

Shipherd, J. C., Stafford, J., & Tanner, L. R. (2005). Predicting alcohol and drug abuse in Persian Gulf War veterans: what role do PTSD symptoms play? *Addictive Behaviors, 30*, 595–599.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. D. (1970). *Manual for the state-trait anxiety inventory (self-evaluation questionnaire)*. Palo Alto, CA: Consulting Psychologists Press.

Stewart, S. H. (1996). Alcohol abuse in individuals expose to trauma: a critical review. *Psychological Bulletin, 120*, 83–112.

SuperLab. (1999). *Pro (Version 2.0). [Computer software]*. San Pedro, CA: Cedrus Corporation.

Terhakopian, A., Sinaii, N., Engel, C. C., Schnurr, P. P., & Hoge, C. W. (2008). Estimating population prevalence of posttraumatic stress disorder: an example using the PTSD checklist. *Journal of Traumatic Stress, 21*, 290–300.

Weathers, F., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility*. Paper presented at the Presentation at the International Society for Traumatic Stress Studies, San Antonio, Texas.

Weierich, M. R., Treat, T. A., & Hollingworth, A. (2008). Theories and measurement of visual attentional processing in anxiety. *Cognition and Emotion, 22*, 985–1018.

Yovel, I. (2003). Anxiety-related attentional biases in the spatial and temporal dimensions. *Dissertation Abstracts Internationa: Section B – the Sciences and Engineering, 64*, 1920.